

WHAT IS CLAIMED IS:

1. A measuring-instrument remote-calibration system for remotely calibrating a measuring instrument, comprising:

converting means for converting a physical standard used as a measuring reference into a transmission signal and for transmitting the signal through a first communication medium; and

calibrating means for receiving and restoring the transmission signal to the measuring reference, and for performing calibration on the measuring instrument based on the measuring reference.

2. A measuring-instrument remote-calibration system according to claim 1, wherein the converting means is located at a standard authority, the calibrating means is located at a remote location, and the standard authority provides certification of the calibration.

3. A measuring-instrument remote-calibration system according to claim 2, wherein results of the calibration are sent from the remote location to the standard authority via a second communication medium.

4. A measuring-instrument remote-calibration system according to claim 3, wherein the first and second communication mediums are the same.

5. A measuring-instrument remote-calibration system according to claim 3, wherein the first and second communication mediums are different.

6. A measuring-instrument remote-calibration system according to claim 1, wherein the physical standard is related to frequency information.

7. A measuring-instrument remote-calibration system according to claim 1, wherein:
the converting means comprises a converting unit and a communication unit located at a standard authority; and
the calibrating means comprises a reception unit and a calibration unit located at a remote location.

8. A measuring-instrument remote-calibration system according to claim 2, wherein the standard authority is the highest national calibration authority.

9. A measuring-instrument remote-calibration system according to claim 2, wherein the remote location is located overseas, relative to the standard authority.

10. A measuring-instrument remote-calibration system according to claim 11, wherein the standard authority performs the certification in accordance with the result of precise measurement involving uncertainty evaluation based on the calibration.

11. A measuring-instrument remote-calibration system according to claims 11, further comprising a remote calibrating network for linking the standard authority and the remote place,

wherein a confirmation of the calibration operation and a confirmation of the precision of the standard are performed by mutually monitoring identical standards retained by a plurality of authorities linked to said remote calibrating network.

12. A measuring-instrument remote-calibration system for calibrating a measuring instrument, comprising:

transporting means for transferring a measurement standard;
calibrating means for receiving the measurement standard, and for performing calibration on a measuring instrument.

13. A measuring-instrument remote-calibration system according to claim 12, wherein:

the transporting means transfers the measurement standard from a standard authority to a remote location;
the calibrating means is located at the remote location; and
the standard authority provides certification of the calibration.

14. A measuring-instrument remote-calibration system according to claim 13, wherein results of the calibration are sent from the remote location to the standard authority via a communication medium.

15. A measuring-instrument remote-calibration system according to claim 13, wherein the transporting means also records environmental characteristics of the environment between the standard authority and the remote location in which it is transported.

16. A measuring-instrument remote-calibration system according to claim 13, wherein the calibrating means transmits the recorded environmental characteristics from the remote location to the standard authority for analysis via a communication medium.

17. A measuring-instrument remote-calibration system according to claim 16, wherein the standard authority determines if the environmental characteristics are within an acceptable range, and if so, instructs the calibrating means via the communication medium to perform the calibration.

18. A measuring-instrument remote-calibration system according to claim 17, wherein, upon instruction from the standard authority, the calibrating means performs the calibration, and transmits the calibration results to the standard authority via the communication medium.

19. A measuring-instrument remote-calibration system according to claim 18, wherein the standard authority receives the calibration results and sends a calibration certificate via the communication medium if the calibration results are satisfactory.

20. A measuring-instrument remote-calibration system according to claim 12, wherein the measurement standard is a physical standard.

21. A measuring-instrument remote-calibration system according to claim 12, wherein the measurement standard is a chemical standard.

22. A measuring-instrument remote-calibration system according to claim 13, wherein the standard authority is the highest national calibration authority.

23. A measuring-instrument remote-calibration system according to claim 13, wherein the remote location is located overseas, relative to the standard authority.

24. A measuring-instrument remote-calibration system according to claim 13, wherein the standard authority performs the certification in accordance with the result of precise measurement involving uncertainty evaluation based on the calibration.

25. A measuring-instrument remote-calibration system according to claims 13, further comprising a remote calibrating network for linking the standard authority and the remote place,

wherein a confirmation of the calibration operation and a confirmation of the precision of the standard are performed by mutually monitoring identical standards retained by a plurality of authorities linked to said remote calibrating network.

26. A measuring instrument remote calibration method comprising:

converting a physical standard used as a measuring reference into a transmission signal;

transmitting the transmission signal by a communication means;

receiving the transmission signal;

restoring the measuring reference from the transmission signal; and

performing calibration based on the measuring reference.

27. A measuring instrument remote calibration method according to claim 26, further comprising performing certification, in accordance with results of the calibration, wherein:

the steps of converting a physical standard and performing certification are performed at a standard authority; and

the steps of restoring the measuring reference and performing calibration are performed at a remote location.

28. A measuring instrument remote calibration method according to claim 27, further comprising transmitting results of the calibration from the remote location to the standard authority; and transmitting a certification certificate from the standard authority to the remote location.

29. A measuring instrument remote calibration method according to claim 27, wherein the steps of transmitting the transmission signal, transmitting results of the calibration, and transmitting a certification certificate are all performed within a single type of communication medium.

30. A measuring instrument remote calibration method according to claim 27, wherein the steps of transmitting the transmission signal, transmitting results of the calibration, and transmitting a certification certificate are performed within various types of communication mediums.

31. A measuring instrument remote calibration method according to claim 27, wherein the standard authority is the highest national calibration authority.

32. A measuring instrument remote calibration method according to claim 27, wherein the remote location is located overseas, relative to the standard authority.

33. A measuring instrument remote calibration method according to claim 26, wherein the step of performing certification is accomplished in accordance with the result of

precise measurement involving uncertainty evaluation based on the step of performing calibration.

34. A measuring instrument remote calibration method according to claim 26, further comprising confirming the precision of the calibration by performing mutual monitoring of identical standards retained by a plurality of standard authorities linked to a remote calibrating network.

35. A measuring-instrument remote-calibration method according to claim 33 wherein, in the step of performing the mutual monitoring, the mutual monitoring is performed between standard authorities nationally and internationally.

36. A measuring-instrument remote-calibration method according to claim 27 wherein:

the standard authority stores highly accurate standards;

the measuring reference is frequency based; and

the certification result is transmitted from the standard authority to the remote location by a communication medium.

37. A measuring instrument remote calibration method according to claim 36, wherein the standard authority and the remote location:

are positioned so that a satellite is simultaneously observed; and

perform frequency calibration by utilizing a signal transmitted from a signal source in the satellite.

38. A measuring instrument remote calibration method according to claim 36, wherein the standard authority and the remote location: are positioned so that a satellite is simultaneously observed; and the frequency standard is restored at the remote location by comparing a reference clock signal included in a signal source in the satellite and a frequency-divided signal from a frequency-controllable oscillator, and feeding back the frequency-divided signal to the frequency-controllable oscillator so that an error signal between both signals is zero.

39. A measuring-instrument remote-calibration method according to claim 37, wherein the satellite is one of a global positioning system satellite and a quasi-zenith satellite.

40. A measuring-instrument remote-calibration method according to claim 38, wherein the satellite is one of a global positioning system satellite and a quasi-zenith satellite.

41. A measuring-instrument remote-calibration method according to claim 37, wherein reception of a plurality of pieces of frequency information from the satellite minimizes an error based on a radio wave propagation delay time caused by dielectric material including a cloud or water vapor positioned between a receiver on the ground and a radio wave transmitter provided in the satellite in a state in which the satellite is over the receiver.

42. A measuring-instrument remote-calibration method according to claim 38, wherein reception of a plurality of pieces of frequency information from the satellite minimizes an error based on a radio wave propagation delay time caused by dielectric material including a cloud or water vapor positioned between a receiver on the ground and a radio wave transmitter provided in the satellite in a state in which the satellite is over the receiver.

43. A measuring-instrument remote-calibration method according to claim 36, wherein, in the step of restoring the measuring reference, a physical quantity directly linked to the frequency is restored by physical law at the remote location.

44. A measuring-instrument remote-calibration method according to claim 43, wherein a Josephson voltage is used as the quantity directly linked to the frequency.

45. A measuring-instrument remote-calibration method according to claim 36, wherein, in the step of restoring the measuring reference, the restored frequency standard is converted into a voltage standard, and based on the restored voltage standard, a physical quantity converted into a voltage is remote-calibrated.

46. A measuring-instrument remote-calibration method, comprising:

generating a physical standard in a standard authority that stores highly accurate standards by using a physical standard generating means integrated with an optical communication path;

transmitting the physical standard by the optical communication path to a calibrated authority at the remote place in which calibration is performed;

performing calibration by restoring the transmitted physical standard in the calibrated authority; and

transmitting a certification result, in accordance with the result of the calibration, from the authority to the calibrated authority by the communication means.

47. A measuring-instrument remote-calibration method according to claim 46, wherein:

the standard authority is a higher-level-standard authority, and an interference signal, caused by a physical quantity used as a reference in the higher-level-standard authority, is transmitted by an optical communication path to a calibrated authority at the remote place in which calibration is performed;

calibration is performed by restoring the transmitted interference signal to a measuring standard in the calibrated authority; and

in accordance with the result of the calibration, a certification result is transmitted from the higher-level-standard authority to the calibrated authority by the communication means.

48. A measuring-instrument remote-calibration method comprising:

transporting a measurement standard;
receiving the measurement standard; and
performing calibration based on the transported measurement standard.

49. A measuring instrument remote calibration method according to claim 48, further comprising performing certification, in accordance with results of the calibration, wherein:

the step of transporting the measurement standard comprises transporting the standard from a standard authority to a remote location;
the step of performing certification is performed at the standard authority; and
the step of performing calibration is performed at the remote location.

50. A measuring instrument remote calibration method according to claim 49, further comprising transmitting results of the calibration from the remote location to the standard authority; and transmitting a certification certificate from the standard authority to the remote location.

51. A measuring instrument remote calibration method according to claim 50, wherein the steps of transmitting results of the calibration and transmitting a certification certificate are all performed within a single type of communication medium.

52. A measuring instrument remote calibration method according to claim 50, wherein the steps of transmitting results of the calibration and transmitting a certification certificate are performed within various types of communication mediums.

53. A measuring instrument remote calibration method according to claim 49, wherein the standard authority is the highest national calibration authority.

54. A measuring instrument remote calibration method according to claim 49, wherein the remote location is located overseas, relative to the standard authority.

55. A measuring instrument remote calibration method according to claim 48, wherein the step of performing certification is accomplished in accordance with the result of precise measurement involving uncertainty evaluation based on the step of performing calibration.

56. A measuring instrument remote calibration method according to claim 48, further comprising confirming the precision of the calibration by performing mutual monitoring of identical standards retained by a plurality of standard authorities linked to a remote calibrating network.

57. A measuring-instrument remote-calibration method according to claim 56 herein, in the step of performing the mutual monitoring, the mutual monitoring is performed between standard authorities nationally and internationally.

58. A measuring-instrument remote-calibration method according to claim 49

wherein:

the standard authority stores highly accurate standards;

the measuring reference is non-frequency based; and

the certification result is transmitted from the standard authority to the remote location by a communication medium.

59. A measuring-instrument remote-calibration method according to claim 49, further comprising:

monitoring an environment wherein the measurement standard is transported;

recording environmental characteristics of the environment;

after the measurement standard is received, the standard authority receives the recorded environmental characteristics from the remote location via a communication medium, and determines whether or not the environment in the record is within an appropriate range of transportation conditions so that the characteristics required for measurement standard are not impaired; and

when the result of calibration at the remote location is within an allowable range, the standard authority transmits the result of certification to the calibrated authority by the communication medium.

60. A measuring instrument remote calibration method according to claim 68,
wherein a temperature, a humidity, an atmosphere, a vibrating acceleration, and a shock are
recorded as the environment characteristics.